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AMENDMENTS TO THE CLAIMS

This listing of claims will replace all prior versions and listings of claims in the application.

Listing of Claims:

Claims 1-30 (Canceled)

Claim 31 (Original): A method of characterizing colors for reproduction between a first device and a second device, the method comprising:

normalizing first tristimulus values indicative of a color of the first device using local black point values;

transforming the normalized first tristimulus values to obtain color values indicative of modified cone response of the human eye;

chromatically adapting the color values from a local condition to a reference condition; and

transforming the adapted color values to obtain second tristimulus values.

Claim 32 (Original): The method of claim 31 wherein a neutral axis of the local condition is mapped to a neutral axis of the reference condition.

Claim 33 (Original): The method of claim 31 wherein normalizing the first tristimulus values includes dividing by a difference between a local luminance value and a local black point luminance value.

Claim 34 (Original): The method of claim 33 wherein transforming the adapted color values includes multiplying the adapted color values by a reference white point luminance value divided by a difference between a local white point luminance value and the local black point luminance value.

Claim 35 (Original): The method of claim 31 wherein transforming the normalized first tristimulus values is performed using a Bradford transformation.

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Claim 36 (Currently Amended): The method of claim 35 wherein normalizing the first tristimulus values and transforming the normalized first tristimulus values are performed according to

$$\begin{bmatrix} R_1 \\ G_1 \\ B_1 \end{bmatrix} = M_b \begin{bmatrix} (X_1 - X_{1K})/(Y_1 - Y_{1K}) \\ (Y_1 - Y_{1K} / (Y_1 - Y_{1K}) \\ (Z_1 - Z_{1K})/(Y_1 - Y_{1K}) \end{bmatrix}$$

$\cancel{[R_1] \quad [(X_1 - X_{1K}) / (Y_1 - Y_{1K})]}$

$\cancel{[G_1] = M_0[(Y_1 - Y_{1K} / (Y_1 - Y_{1K})]}$

$\cancel{[B_1] \quad [(Z_1 - Z_{1K}) / (Y_1 - Y_{1K})]}$

where $[X_{1K}, Y_{1K}, Z_{1K}]$ is the local black point, X_1, Y_1, and Z_1, are the first tristimulus values,

$$M_b = \begin{bmatrix} 0.8951 & 0.2664 & -0.1614 \\ -0.7502 & 1.7135 & -0.0367 \\ 0.0389 & -0.0685 & 1.0296 \end{bmatrix}$$

$\cancel{[0.8951 \quad 0.2664 \quad 0.1614]}$

$\cancel{M_0 = [-0.7502 \quad 1.7135 \quad 0.0367]}$

$\cancel{[0.0389 \quad 0.0685 \quad 1.0296]}$ ~~, and~~

where R_1, G_1, and B_1 are the color values indicative of modified cone responses of the human eye and M_b is a Bradford matrix.

Claim 37 (Currently Amended) The method of claim 36 wherein chromatically adapting the color values is performed according to

$$R_{ref} = (R_{rw}/R_{1w}) \times R_1$$

$$G_{ref} = (G_{rw}/G_{1w}) \times G_1$$

$$B_{ref} = \mathrm{Sign}(B_1) \times (B_{rw}/B_{1w}^{3\beta}) \times |B_1|^{\beta 3}$$

$$\beta = (B_{1w}/B_{rw})^{0.0836}$$

where R_{rw}, G_{rw} and B_{rw} and RGB values of a reference white point, R_{1w}, G_{1w}, and B_{1w} are RGB values of a local white point, <u>β is an adjustment factor, and R_{ref}, G_{ref}, and B_{ref} are cone responses adapted from local to reference values</u>.

Claim 38 (Currently Amended) The method of claim 37 wherein transforming the adapted color values to second tristimulus values is performed according to

$$\cancel{[X_{ref}] \qquad [R_{ref}\ \mathrm{x}\ Y_1\ \mathrm{x}\ Y_{rw} / (Y_{1w} - Y_{1k})]}$$
$$\cancel{[Y_{ref}] = M_e^{-1} \qquad [G_{ref}\ \mathrm{x}\ Y_1\ \mathrm{x}\ Y_{rw} / (Y_{1w} - Y_{1k})]}$$
$$\cancel{[Z_{ref}] \qquad [B_{ref}\ \mathrm{x}\ Y_1\ \mathrm{x}\ Y_{rw} / (Y_{1w} - Y_{1k})]}$$

$$\begin{bmatrix} X_{ref} \\ Y_{ref} \\ Z_{ref} \end{bmatrix} \underline{= M_y^{-1}} \begin{bmatrix} R_{ref}\ \mathrm{x}\ Y_1\ \mathrm{x}\ Y_{rw} / (Y_{1w} - Y_{1k}) \\ G_{ref}\ \mathrm{x}\ Y_1\ \mathrm{x}\ Y_{rw} / (Y_{1w} - Y_{1k}) \\ B_{ref}\ \mathrm{x}\ Y_1\ \mathrm{x}\ Y_{rw} / (Y_{1w} - Y_{1k}) \end{bmatrix}$$

<u>where X_{ref}, Y_{ref}, and Z_{ref} are the second tristimulus values.</u>

Claim 39 (Original): The method of claim 31 wherein transforming the normalized first tristimulus values is performed using a von Kries transformation.

Claim 40 (Currently Amended) The method of claim 39 wherein

$$\cancel{[X_{ref}] \qquad [L_{rw} \quad 0 \quad 0][1/(L_{1w} - L_{1k}) \ 0 \ 0] \qquad [X_1]}$$
$$\cancel{[Y_{ref}] = M_y^{-1} \qquad [0 \quad M_{rw} \quad 0][0 \quad 1/(M_{1w} - M_{1k}) \quad 0] M_y [Y_1]}$$
$$\cancel{[Z_{ref}] \qquad [0 \quad 0 \quad S_{rw}][0 \quad 0 \quad 1/(S_{1w} - S_{1k})] \qquad [Z_1]}$$

$$\underline{\begin{bmatrix} X_{ref} \\ Y_{ref} \\ Z_{ref} \end{bmatrix}} \underline{= M_y^{-1}}$$
$$\underline{\begin{bmatrix} L_{rw} & 0 & 0 \\ 0 & M_{rw} & 0 \\ 0 & 0 & S_{rw} \end{bmatrix}} \begin{bmatrix} 1/(L_{1w} - L_{1k}) & 0 & X_1 \\ 0 & 1/(M_{1w} - M_{1k}) & 0 \\ 0 & 0 & 1/(S_{1w} - S_{1k}) \end{bmatrix} \underline{M_y} \underline{\begin{bmatrix} X_1 \\ Y_1 \\ Z_1 \end{bmatrix}}$$

where

$$\cancel{[0.38791 \quad 0.68898 \quad -0.07868]}$$
$$\cancel{M_y = [-0.22981 \quad 1.18340 \quad 0.04641]}$$

~~[0 0 1.0]~~

$$M_v = \begin{bmatrix} 0.38791 & 0.68898 & -0.07868 \\ -0.22981 & 1.18340 & 0.04641 \\ 0 & 0 & 1.0 \end{bmatrix}$$

and where (L_{ref}, M_{ref}, S_{rw}) are LMS (long, medium, and short wavelength band) values for local white, (L_{1k}, M_{1k}, S_{1k}) are LMS values for local black X_1, Y_1, and Z_1 are the first tristimulus values, and X_{ref}, Y_{ref}, and Z_{ref} are the second tristimulus values.

Claim 41 (Currently Amended): The method of claim 31, wherein the first device is a print device and the second device is a print device, tristimulus values of a common illuminant are used as reference tristimulus white values for ~~both~~ the print devices, media white tristimulus values of each of the print devices are used as local tristimulus white values for ~~both~~ the print devices, and Bradford-type adaptations are used for ~~both~~ the print devices to implement media-relative colorimetry.

Claim 42 (Currently Amended): The method of claim 31 wherein the first device is a print device and the second device is a display device, tristimulus values of a reference illuminant are used as reference tristimulus white values, media white tristimulus values of the print device are used as local tristimulus white values for the print device, monitor white tristimulus values of the display devices, and Bradford-type adaptations are used for ~~both~~ the first and second devices to implement media-relative colorimetry.

Claim 43 (Currently Amended): The method of claim 31 wherein the first device is a print device and the second device is a display device, tristimulus values of a reference illuminant are used as reference tristimulus white values for the display device, media white tristimulus values of the print device are used as local tristimulus white values, monitor white tristimulus values of the display device are used as local tristimulus values for the display device, Bradford-type adaptation is used for the display device, and absolute CIE-Lab is used for the print device to implement absolute colorimetry.

Claim 44 (Previously Presented): A computer-readable medium comprising instructions for characterization of colors for reproduction between a first device and a second device, the instructions causing a processor to:

normalize first tristimulus values indicative of a color of the first device using local black point values;

transform the normalized first tristimulus values to obtain color values indicative of modified cone response of the human eye;

chromatically adapt the color values from a local condition to a reference condition; and

transform the adapted color values to obtain second tristimulus values.

Claim 45 (Currently Amended) The computer-readable medium of claim 44 wherein the instructions cause the processor to normalize the first tristimulus values by dividing by a difference between a local luminance value and a local black point luminance values,

wherein the instructions cause the processor to transform the adapted color values by multiplying the adapted color values by a reference white point luminance value divided by a difference between a local white point luminance value and the local black point luminance value, and wherein the instructions cause the processor to transform the normalized first tristimulus values using a Bradford transformation, and

wherein the instructions cause the processor to normalize the first tristimulus values and transform the normalized first tristimulus values according to:

~~[R_1] [$(X_1$-$X_{1K})$ / $(Y_1$-$Y_{1K})$]~~

~~[G_1] = [M_b[$(Y_1$-Y_{1K} / $(Y_1$-$Y_{1K})$]~~

~~[B_1] [$(Z_1$-$Z_{1K})$ / $(Y_1$-$Y_{1K})$]~~

$$\underline{\begin{bmatrix} R_1 \\ G_1 \\ B_1 \end{bmatrix} = M_b \begin{bmatrix} (X_1 - X_{1K})/(Y_1 - Y_{1K}) \\ (Y_1 - Y_{1K} / (Y_1 - Y_{1K}) \\ (Z_1 - Z_{1K})/(Y_1 - Y_{1K}) \end{bmatrix}}$$

where $[X_{1K}, Y_{1K}, Z_{1K}]$ is the local black point, X_1, Y_1, and Z_1 are the first tristimulus values,

~~[0.8951 0.2664 0.1614]~~

~~M_b= [-0.7502 1.7135 0.0367]~~

~~[0.0389 0.0685 1.0296],~~

$$\underline{M_b = \begin{bmatrix} 0.8951 & 0.2664 & -0.1614 \\ -0.7502 & 1.7135 & -0.0367 \\ 0.0389 & -0.0685 & 1.0296 \end{bmatrix}} \text{ and}$$

<u>where</u> R_l, G_l, and B_l are the color values indicative of modified cone responses of the human eye <u>and M_b is a Bradford matrix</u>.

Claim 46 (Currently Amended): The computer-readable medium of claim ~~46~~ <u>45</u>, wherein the instructions cause the processor to chromatically adapt the color values according to:

$$R_{ref} = (R_{rw}/R_{lw}) \times R_l$$
$$G_{ref} = (G_{rw}/G_{lw}) \times G_l$$
$$B_{ref} = \mathrm{Sign}(B_l) \times (B_{rw}/B_{lw}{}^{\beta 3}) \times |B_l|^{\beta 3}$$
$$\beta = (B_{lw}/B_{rw})^{0.0836}$$

where R_{rw}, G_{rw} and B_{rw} and RGB values of a reference white point, R_{lw}, G_{lw}, and B_{lw} are RGB values of a local white point, <u>β is an adjustment factor, and R_{ref}, G_{ref}, and B_{ref} are cone responses adapted from local to reference values</u> and

wherein the instructions cause the processor to transform the adapted color values to second tristimulus values is performed according to:

$$\cancel{[X_{ref}] \quad [R_{ref} \times Y_l \times Y_{rw} / (Y_{lw} - Y_{lk})]}$$
$$\cancel{[Y_{ref}] = M_n^{-1} \quad [G_{ref} \times Y_l \times Y_{rw} / (Y_{lw} - Y_{lk})]}$$
$$\cancel{[Z_{ref}] \quad [B_{ref} \times Y_l \times Y_{rw} / (Y_{lw} - Y_{lk})].}$$

$$\underline{\begin{bmatrix} X_{ref} \\ Y_{ref} \\ Z_{ref} \end{bmatrix} = M_v^{-1} \begin{bmatrix} R_{ref} \times Y_l \times Y_{rw} / (Y_{lw} - Y_{lk}) \\ G_{ref} \times Y_l \times Y_{rw} / (Y_{lw} - Y_{lk}) \\ B_{ref} \times Y_l \times Y_{rw} / (Y_{lw} - Y_{lk}) \end{bmatrix}}$$

<u>where X_{ref}, Y_{ref}, and Z_{ref} are the second tristimulus values and M_v is a von Kries matrix.</u>

Claim 47 (Currently Amended) The computer-readable medium of claim 44, wherein the instructions cause the processor to transform the normalized first tristimulus values using a von Kries transformation, wherein

$$\cancel{[X_{ref}] \quad [L_{rw} \quad 0 \quad 0][1/(L_{lw} - L_{lk}) \, 0] \quad [X_l]}$$

~~[Yref] = My-1 [0 Mrw 0][0 1/(M1w-M1k) 0]My[Y1]~~
~~[Zref] [0 0 Srw][0 0 1/(S1w-S1k)] [Z1]~~

$$\begin{bmatrix} X_{ref} \\ Y_{ref} \\ Z_{ref} \end{bmatrix} = M_V^{-1}$$

$$\begin{bmatrix} L_{rw} & 0 & 0 \\ 0 & M_{rw} & 0 \\ 0 & 0 & S_{rw} \end{bmatrix} \begin{bmatrix} 1/(L_{1w} - L_{1k}) & 0 & X_l \\ 0 & 1/(M_{lw} - M_{lk}) & 0 \\ 0 & 0 & 1/(S_{lw} - S_{lk}) \end{bmatrix} M_V \begin{bmatrix} X_l \\ Y_l \\ Z_l \end{bmatrix}$$

where

~~[0.38791 0.68898 0.07868]~~
~~My = [-0.22981 1.18340 0.04641]~~
~~[0 0 1.0]~~

$$M_V = \begin{bmatrix} 0.38791 & 0.68898 & -0.07868 \\ -0.22981 & 1.18340 & 0.04641 \\ 0 & 0 & 1.0 \end{bmatrix}$$

and where (L_{ref}, M_{ref}, S_{rw}) are LMS (long, medium, and short wavelength band) values for local white, (L_{1k}, M_{1k}, S_{lk}) are LMS values for local black X_l, Y_l, and Z_l are the first tristimulus values, and X_{ref}, Y_{ref}, and Z_{ref} are the second tristimulus values and M_V is a von Kries matrix.

Claim 48 (Currently Amended): The computer-readable medium of claim 44, wherein the first-device is a print device and the second device is a print device, tristimulus values of a common illuminant are used as reference tristimulus white values for ~~both~~ the print devices, media white tristimulus values of each print device are used as local tristimulus white values for ~~both~~ the print devices, and Bradford-type adaptations are used for both print devices to implement media-relative colorimetry.

Claim 49 (Currently Amended): The computer-readable medium of claim 44, wherein the first device is a print device and the second device is a display device, tristimulus values of a reference illuminant are used as reference tristimulus white

values, media white tristimulus values of the print device are used as local tristimulus white values for the print device, monitor white tristimulus values of the display device are used as local tristimulus values for the display device, and Bradford-type adaptations are used for ~~both the first and second~~ the devices to implement media-relative colorimetry.

Claim 50 (Currently Amended): The computer-readable medium of claim 44, wherein the first-device is a print device and the second device is a display device, tristimulus values of a reference illuminant are used as reference tristimulus white values for the display device, media white tristimulus values of the print device are used as local tristimulus white values, monitor white tristimulus values of thedisplay device are used as local tristimulus values for the display device, Bradford-type adaptation is used for the display device, and absolute CIE-Lab is used for the print device to implement absolute colorimetry.